





Inherent auction factors that affect the selling price of calves

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ABSTRACT - This study was performed to determine and quantify the inherent auction factors that affect the selling price of beef calves (weanlings - from six to nine months old). Data on the selling price, location and month of the auction, genetic group, lot size live weight, and sex of animals were collected in 148 auctions from January 2004 to December 2014. A total of 4,312 lots corresponding to 48,588 calves were classified into seven genetic groups according to their phenotypic characteristics. The values were deflated using the General Price index (IGP-DI) inflation index and met the parametric assumptions. The selling price was standardized by the yearly median, assuming that its value corresponds to 100%, and the other values varied in their function. Path analysis quantified the direct and indirect effects of the variables taken as explanatory of the selling price, followed by regression analysis and Tukey test. Overall, the direct effect of the average weight was the highest (0.7), followed by sex (0.38). The smallest direct effect was the genetic group (-0.075). There was a growing exponential relationship between average weight of the lot and selling price and a decreasing ratio between price per kilo and the average weight of the lot (-0.0003 percentage points per kilogram). Males were generally 15.7% more valued than females. The British × Zebuine crossbreed was the most valued breed, followed by the British breed (8.9 and 3.6%, respectively). The highest premium was in November, followed by February (9.57 and 8.84%, respectively, compared with median year). The selling price increases linearly by 0.3284 percentage points for each additional animal in the lot. The average weight of the lot was found to be the most important variable in the formation of the selling price, followed by the sex of the animals.

Keywords: beef cattle, marketing, profitability

Introduction

The success of beef cattle production is closely linked to the reproductive performance of the herd, maternal efficiency, and fertility, as they are the cornerstone of the economic activity (Haddad and Mendes, 2010). In any beef calf system, the decision to keep or send matrices to slaughter acts a regulation factor in divesting or investing in the activity. According to Lord et al. (2015), the profitability for cow-calf farmers is a function of multiple input (feed) prices and output (calves) markets. Input and market price fluctuations cause the farmer to adjust the method of production of animals (e.g., culling versus retaining open females).

Most calf sellers market their product through auctions, which is a marketing system in which the rules are mediated through the auctioneer (Machado Filho and Zylbersztajn, 1999). In terms of general

market information, farmers have a natural tendency to seek price information locally as they believe that this information is more reliable (Troxel and Barham, 2007). In this way, in addition to providing a commercialization route, the function of a livestock auction is to enable price discovery, thus generating market information for regional farmers regarding the calf market.

Price volatility differs between commodity groups; for primary commodities (agricultural and livestock), volatility is part of supply disruptions, while raw materials (industry) suffer from fluctuations in demand. The interaction between short-term demands and supply elasticity may result in price fluctuations. However, there are many factors that influence the selling price of beef calves at auctions, some of which may change according to the genetic group (weight, sex, breed, marketing month, and lot size). The purpose with this study was to determine and quantify the inherent factors in auction that affect the selling price of beef calves. With these results, we expected to provide guidance to both buyers and calf farmers, aiming at maximizing the profitability of the livestock system.

Material and Methods

The study was conducted using data on the commercialization of beef calves from an auction company in Southwest Paraná, Brazil. Data from 4,312 lots totaling 48,588 animals weighing between 100 and 250 kg, marketed in 148 auctions in the cities of Dois Vizinhos (DV) and Francisco Beltrão (FB) between January 2004 and December 2014 (Table 1) were used.

The auction agenda was arranged between the farmers associations of each municipality and the auction company. Auctions were promoted via direct mail, website, SMS, fax, social networks, and phone calls the week before each event to confirm the number of animals that would be for sale and to confirm the presence of possible buyers. The animals were inspected by staff of the auctioneer and by the technical officer registered in the Agência de Defesa Agropecuária do Paraná (ADAPAR). To ensure uniformity, they were separated on arrival according to their phenotype (breed characteristics such as skin color and horns). The auctioneer's staff was responsible for collecting the owner's name, the number and average weight of the animals, their sex, genetic group, and lot number. All the collected data were entered into the operating system of the auction house.

The auctions followed the English method, with minimum bid pre-established between the sellers and the auctioneer. The breed classification of the lots was carried out by qualified employees of the auction company. The 49 observed genetic groups were grouped (Table 2): British, Continental, Zebuine, British × Continental, British × Zebuine, and Continental × Zebuine. The lots denominated as genetically Ununiform were those with no breed standardization, that is, there were animals of various genetic groups in the same lot.

Table 1 - Summary of the data collected for the survey, from archives of the auctioned company

Genetic group	Lot		Number of animals		Total (%)	Average weight (kg)
	Males	Females	Males	Females		
British	182	170	2109	2065	8	193.32
British × Continental	16	13	144	138	1	193.41
British × Zebuine	195	192	2338	2191	9	198.73
Continental	145	110	1434	1201	6	199.56
Continental × Zebuine	196	162	2126	1682	8	197.38
Genetically ununiform	306	176	2651	1712	11	198.55
Zebuine	1392	1057	16,539	12,258	57	193.14
Total	2432	1880	27,341	21,247	100	-
	4312		48,588			

The values were deflated through the General Price index (IGP-DI) for September 2015 and, after checking possible outliers via the box-plot chart, the variance homogeneity and data normality were checked using Bartlett's and Shapiro-Wilk tests, respectively.

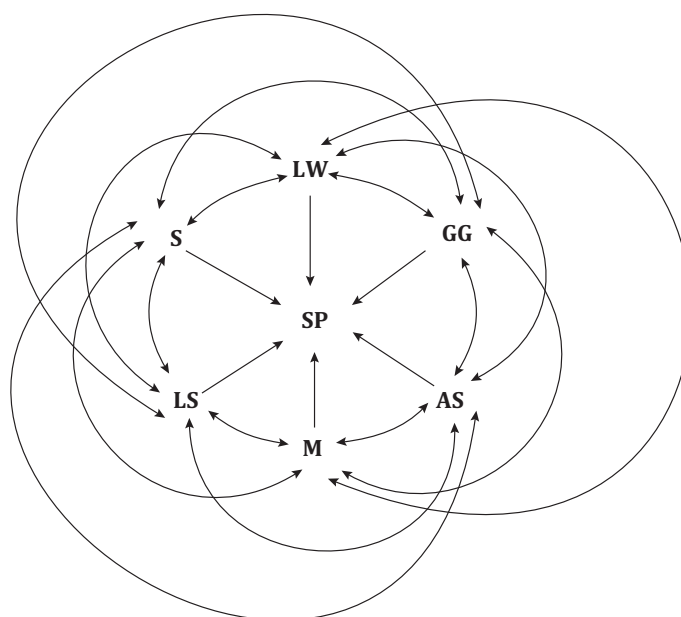
The price fluctuations related to the livestock cycle were controlled through the standardization of the selling price as a function of the annual median. Medians, which were assigned values corresponding to 100% for males and females were calculated for each year; the other values varied in their function. Values above the median were considered premiums, and those below the median were considered discounts.

The data set was analyzed year-by-year and whole data, and the standardized price was maintained for possible comparisons. A causal model (Figure 1) was constructed to verify the possible relationship between the explanatory variables: auction site and month, genetic group, lot size, live weight, and sex of the animals with the response selling price.

The model was fitted by the partial least squares method obtaining the path coefficients. The Z test was performed to determine the significance of the coefficients and the consequent effectiveness of the causal model.

Table 2 - Distribution of genetic classes according to the observed genetic group

Class	Genetic group
British	Angus, Hereford, Devon, Angus × Hereford, Angus × Devon, Hereford × Devon
Continental	Charollais, Simental, Limousin, Marchigiana, Caracu
Zebuine	Nellore, Tabapuã, Brahman, Guzerá, Nellore × Tabapuã, Nellore × Brahman
British × Continental	Angus × Charolês, Angus × Limousin, Angus × Marchigiana, Angus × Simental
British × Zebuine	Angus × Nellore, Hereford × Nellore, Angus × Tabapuã, Hereford × Tabapuã, Brangus, Braford
Continental × Zebuine	Charollais × Nellore, Marchigiana × Nellore, Simental × Nellore, Charollais × Tabapuã, Marchigiana × Tabapuã, Caracu × Nellore, Caracu × Tabapuã, Charollais × Brahman, Canchim
Ununiform	Mix of breeds in the same lot.



SP - selling price; LS - lot size; GG - genetic group; S - sex of the animal; M - auction month; AS - auction site; LW - live weight.

Figure 1 - Causal diagrams indicating the interrelationship between the analyzed variables.

The direct and indirect effects of the explanatory variables on the basic variable were established through the decomposition of the correlation coefficients. The direct effects of the explanatory variables on the response variable was multiplied by the correlation between the explanatory variables to calculate the indirect effects.

The variables that showed a significant correlation with the selling price were used in the following additive linear model (equation 1), which was fitted to the whole data and subjected to analysis of variance, post-hoc tests, and regression analysis.

$$Y = X\beta + \varepsilon \quad (1)$$

in which Y is an $n \times 1$ vector of observed selling prices, X is an $n \times p$ design matrix of the explanatory variables, β is a $p \times 1$ vector of unknown parameters, ε is an $n \times 1$ vector of random errors, n is the sample size, and p is the number of possible explanatory variables.

For the qualitative variables: sex, genetic group, auction location, and month, the comparison of the means was performed using Tukey's test. Regression analysis for live weight and lot size was tested until the third order. We used functions developed on R (Core Team, 2019) with packages `plspm` (Sanchez et al., 2017), `lavaan` (Rosseel, 2012), and `agricolae` (Mendiburu, 2019).

Results

Significant results were observed for all path coefficients and direct and indirect effects of the explanatory variables on the basic variable, indicating the individual contribution of each variable in the formation of the selling price (Table 3). The coefficient of determination (r^2) could be used to verify that the variables explained 65 to 83.8% of the selling price. Weight contributed the most to the price, followed by sex, while month contributed the least (Table 3). The mean weight of the lot had a greater direct effect than the residual effect ($P < 0.05$) in all years and overall data set (Table 3); this variable is assumed to be the main determinant in the formation of selling price. A direct relationship between weight and selling price (Standardized price/calf = $10.89 + 0.4642 * \text{weight}$, $P < 0.0001$; $r^2 = 0.51$) (Figure 2) was observed in all genetic groups, sexes, and years. According to the regression analysis, animals began to attract a premium from 192 kg onwards, while animals below that weight were discounted. On the other hand, this effect was found to decrease when the price per kg was used. The price declined by -0.0003 percentage points for every kilogram increase in the weight of the animal (Figure 2).

The direct effect of sex on price ($P < 0.05$) was greater than the effect of the residual variable only in 2005 and 2006 (Table 3), indicating its direct contribution to the formation of the selling price in those years. However, even with negative or positive indirect influence of the other variables, the sex correlation coefficient was not higher than the residual effect in the other years and overall, demonstrating that sex did not significantly contribute to the construction of the selling price in those years.

The direct effect of the genetic group on price was not significant ($P > 0.05$) from 2004 to 2007, and in 2009 and 2010. Its direct effect ($P < 0.05$) was negative (Table 3) in other years and overall, and higher values were observed in 2012 and 2013 (-0.207 and -0.19 , respectively). These effects were smaller than the residual variable, indicating that the genetic group did not directly affect the selling price.

Regarding the month of supply of calves, there was a lower availability during the winter (12%). During the spring, the availability was mainly in November (Table 4). The direct effect of month on selling price ($P < 0.05$) ranged from -0.188 to 0.185 , which was lower than the residual variable effect (Table 3), indicating that month did not affect price directly. The indirect contribution of lot size was very small. The effect was not greater than the residual effect, indicating that lot size did not affect selling price. However, except for the year 2005, the direct effect of lot size on selling price was significant ($P < 0.05$) for all years and overall.

Table 3 - Path coefficients and adjustment quality indicators of the explanatory variables model (P<0.05) mean weight, sex, genetic group, site, month, and lot size over the basic variable selling price

	Estimation of path coefficients											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Geral
	Weight											
Direct effect on selling price	0.790*	0.799*	0.790*	0.611*	0.665*	0.704*	0.723*	0.660*	0.737*	0.726*	0.663*	0.700*
Indirect effect via lot size	-0.008*	NS	-0.004*	-0.002*	0	-0.012*	-0.004*	0.018*	-0.015*	-0.004*	0.010*	-0.003*
Indirect effect via month	0	0.003*	-0.005*	-0.008*	-0.002*	NS	NS	-0.012*	NS	NS	0.005*	0
Indirect effect via sex	-0.028*	-0.015*	0.012*	0.044*	0.027*	0.033*	0.025*	0.029*	0	-0.021*	0.017*	0.012*
Indirect effect via genetic group	NS	NS	NS	NS	0.003*	NS	NS	0.011*	-0.006*	0.001*	-0.002*	0.003*
Total	0.735*	0.785*	0.803*	0.644*	0.694*	0.725*	0.742*	0.713*	0.716*	0.709*	0.695*	0.714*
	Sex											
Direct effect on selling price	0.362*	0.467*	0.410*	0.381*	0.436*	0.391*	0.382*	0.378*	0.265*	0.463*	0.371*	0.383*
Indirect effect via lot size	-0.001*	NS	-0.003*	0.005*	0.003*	0.003*	-0.010*	0.018*	0.004*	-0.008*	0.002*	0
Indirect effect via month	0.021*	0	0.007*	-0.006*	-0.004*	NS	NS	0	NS	NS	NS	0
Indirect effect via genetic group	NS	NS	NS	NS	-0.004*	NS	NS	-0.004*	-0.015*	-0.013*	-0.013*	-0.003*
Indirect effect via live weight	-0.061*	-0.026*	0.023*	0.070*	0.041*	0.059*	0.048*	0.051*	0.001*	-0.033*	0.030*	0.022*
Total	0.321*	0.435*	0.437*	0.471*	0.470*	0.453*	0.402*	0.445*	0.255*	0.403*	0.388*	0.402*
	Genetic group											
Direct effect on selling price	NS	NS	NS	NS	-0.077*	NS	NS	-0.120*	-0.207*	-0.190*	-0.111*	-0.075*
Indirect effect via lot size	NS	NS	NS	NS	0.003*	NS	NS	0.010*	0.010*	-0.027*	-0.012*	0.001*
Indirect effect via month	NS	NS	NS	NS	-0.002*	NS	NS	0.002*	NS	NS	-0.002*	0
Indirect effect via sex	NS	NS	NS	NS	0.020*	NS	NS	0.012*	0.020*	0.032*	0.044*	0.015*
Indirect effect via live weight	NS	NS	NS	NS	-0.026*	NS	NS	-0.061*	-0.021*	-0.005*	0.014*	-0.025*
Total	NS	NS	NS	NS	-0.080*	NS	NS	-0.157*	-0.210*	-0.20*	-0.062*	-0.083*
	Month											
Direct effect on selling price	-0.188*	0.059*	0.110*	0.185*	-0.064*	NS	NS	-0.069*	NS	NS	0.101*	0.027*
Indirect effect via lot size	0.006*	0.002*	-0.002*	0.007*	0.010*	NS	NS	0.015*	NS	NS	0.022*	0.012*
Indirect effect via sex	-0.040*	-0.006*	0.027*	-0.013*	0.025*	NS	NS	-0.004*	NS	NS	0.002*	-0.001*
Indirect effect via genetic group	NS	NS	NS	NS	-0.002*	NS	NS	0.003*	NS	NS	0.002*	0
Indirect effect via live weight	-0.014*	0.045*	-0.037*	-0.025*	0.017*	NS	NS	0.119*	NS	NS	0.030*	0.023*
Total	-0.174*	0.105*	0.058*	0.165*	-0.022*	NS	NS	0.062*	NS	NS	0.154*	0.056*
	Lot size											
Direct effect on selling price	0.093*	NS	0.056*	0.087*	0.092*	0.092*	0.092*	0.115*	0.170*	0.129*	0.106*	0.111*
Indirect effect via month	-0.011*	NS	-0.004*	0.016*	-0.013*	NS	NS	-0.009*	NS	NS	0.021*	0.003*
Indirect effect via sex	-0.006*	NS	-0.025*	0.022*	0.015*	0.015*	-0.040*	0.004*	0.006*	-0.030*	0.008*	-0.002*
Indirect effect via genetic group	NS	NS	NS	NS	-0.006*	NS	NS	-0.010*	-0.013*	0.040*	0.012*	0

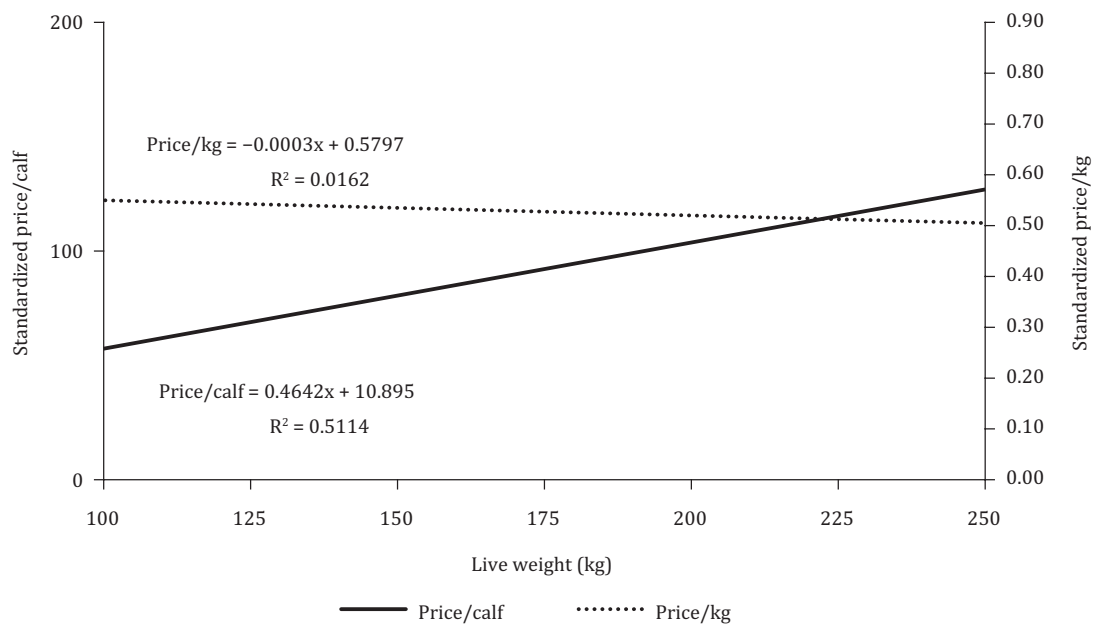
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Table 3 (Continuation)

	Estimation of path coefficients											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Geral
Indirect effect via live weight	-0.067*	NS	-0.061*	-0.012*	0.003*	-0.091*	-0.035*	0.101*	-0.064*	-0.024*	0.066*	-0.017*
Total	0.015*	NS	-0.052*	0.109*	0.078*	0.014*	0.035*	0.208*	0.133*	0.129*	0.201*	0.091*
Determination coefficient	0.728*	0.838*	0.834*	0.666*	0.689*	0.691*	0.709*	0.683*	0.683*	0.769*	0.650*	0.675*
Residual effect	0.52*	0.40*	0.41*	0.58*	0.56*	0.56*	0.54*	0.56*	0.56*	0.48*	0.59*	0.57*
Determinant of matrix	0.21*	0.15*	0.15*	0.31*	0.29*	0.29*	0.25*	0.28*	0.25*	0.19*	0.29*	0.31*
Number of conditions	13.62*	23.60*	22.59*	9.99*	10.84*	11.02*	11.96*	11.12*	10.82*	16.16*	9.61*	10.23*
Inflation factors of variance	3.68*	6.17*	6.02*	2.99*	3.22*	3.24*	3.44*	3.15*	3.15*	4.33*	2.86*	3.08*

NS - not significant.

* Significant at 0.05 probability of error.



Standardized price: median = 100.

Figure 2 - Standardized price per kilogram and head according to the average weight of the lot.

There was a 15.75% difference in the price of males compared with females. Premiums were 8.27% above the general median for males, but discounts were 7.48% below the general median for females (Table 5).

British animals were more highly valued than the others (Table 6). British × Zebuine animals were the most highly valued at 8.93% above the median price, while the pure British were valued at 3.57% above the median. On the other hand, the Ununiform lots were the only ones that were discounted, with a price 3.56% lower than the median. Another notable result was that the majority (57%) of the animals sold in the region were Zebuine, even though they did not have the highest selling price.

The best prices were obtained at auctions held in November (9.57% above the median) and February (8.84% premium).

Table 4 - Standardized price and average weight of the lot as a function of the marketing month

Month	Premiums and discounts % relative to the median of the year*	Total % marketed
January	1.21cd	7
February	8.84ab	2
March	4.34bc	25
April	1.10cd	12
May	-4.33ef	15
June	-8.23ef	2
July	-6.91ef	2
August	-2.49de	9
September	-12.20f	1
October	-1.60de	7
November	9.57a	14
December	3.39bcd	3
Total		100

a-f - Means followed by the same letter in the columns did not differ by Tukey's test ($P < 0.05$).

* Difference between category price and median of all animals.

Table 5 - Standardized price and average lot weight according to sex

	Premium and discounts % relative to the median of the year*	Lot
Males	8.27a	2432
Females	-7.48b	1880

a,b - Means followed by the same letter in the columns do not differ by Tukey's test ($P < 0.05$).

* Difference between category price and median of all animals.

Table 6 - Standardized price and average weight of the lot according to the genetic group

Genetic group	Premium and discounts % relative to the median of the year*	Total % marketed
British × Zebuine	8.93a	9
British	3.57ab	8
Continental	1.19bc	6
British × Continental	0.98bc	1
Zebuine	0.98bc	57
Continental × Zebuine	0.92bc	8
Genetically ununiform	-3.56c	11
Total		100

a-c - Means followed by the same letter in the columns did not differ by Tukey's test ($P < 0.05$).

* Difference between category price and median of all animals.

Discussion

The determinants of the correlation matrix (0.15 to 0.31) presented values that were not close to zero, and none of the values of the inflation factors of the variance were greater than 10. This indicates that the multicollinearity was weak, assuring the reliability of the obtained results (Cruz and Carneiro, 2006).

Similarly to the results of Christofari et al. (2010) and Lopes et al. (2017), the average weight of the lot was the main variable responsible for the selling price. With increasing production costs, rearing

animals that were already closer to slaughter weight was an important factor for the profitability of livestock activity. In line with Troxel and Barham (2012), the price fell despite the appreciation of relatively heavy animals (price per kg). This decline was due to the impossibility of purchasing a heavy animal with high added value. Christofari et al. (2010) suggested that the buyer can use the strategy of acquiring lighter calves and purchase more units at a lower price, especially when the price per kg for calves is higher than that of steers for fattening. The decline is higher for males, as heavy females tend to be used in breeding (Schroeder et al., 1988; Dhuyvetter and Schroeder, 1999; Smith et al., 2000). It is, therefore, essential to produce quality calves, because any investment in the breeding phase that results in increased efficiency will benefit the entire supply chain (Euclides Filho, 2000).

We analyzed 2,432 batches of males and 1,880 batches of females (Table 5), in which the price paid for males was higher (15.75%) than that for females ($P < 0.05$). Fornari et al. (2016) evaluated auctions in the state of Santa Catarina in Brazil and found the average price of males was 6.78% higher than that of females. Koetz Júnior et al. (2014) observed an 11.5% difference in the price of male calves in relation to females in the northern part of the state of Paraná, Brazil. Similar results were obtained by Crespo et al. (2006) in Uruguay and by Troxel and Barham (2012) in the state of Arkansas, USA. According to Fornari et al. (2016), the higher price paid for males may be related to the greater potential for weight gain during rearing and fattening, in addition to greater final value at slaughter. On the other hand, farmers generally purchase females for replacement of matrices, and they are sold at lower prices at the end of their reproductive life.

The sex of the animal affected the results in all years, despite the years of 2005 and 2006 having a direct effect on the price formation of calves. In those years, the price of live cattle reached the lowest price in the last 50 years. That is likely to be due to the increase in production costs and health problems such as foot-and-mouth disease (Moraes et al., 2017). In times of economic crisis, the farmer tended to buy less and choose better-quality animals. In addition, there is less retention of females, having greater supply of this type of animal in the market, reducing, consequently, its value.

Both the direct and indirect effects of genetic group had no significant effect in terms of price between 2004 and 2010, except for a small contribution in 2008. However, in the years 2011 to 2014, genetic group began to contribute to pricing. This behavior was due to the introduction of premium programs for certain genetic groups in the region, where the farmer receives a premium for fattening specific breeds such as Angus and Hereford, for example.

A total of 49 genetic groups, classified into seven genetic groups, were observed in the data set. In general, Zebuine breeds accounted for 57% of the animals traded in the period (Table 6). However, in 2014, these animals accounted for 43% of commercialized genetic groups as the proportion of British animals had increased to 24%. This increase was mainly due to promotion carried out by breed associations in partnership with slaughterhouses for the purchase of specific breeds, mainly Hereford and Angus (ABHB, 2015). According to Saab et al. (2009), market alliances have been created to serve differentiated market segments. These authors highlighted that alliances and contracts, either formal or informal, generally guarantee that the investments made to seek superior animal quality are worthwhile in terms of financial returns. Animals from British × Zebuine and British genetic groups fetched higher prices and received premiums of 8.93% and 3.57%, respectively (Table 6). Christofari et al. (2008) and Koetz Júnior et al. (2014) also an increase in the value of British × Zebuine and British animals. Troxel and Barham (2012) argued that the genetic group affects the selling price of beef calves in Arkansas, with Aberdeen Angus being the most valued. Gonçalves et al. (2018) observed higher prices paid per kg of crossbreed and European calves.

Lots without genetic standardization (Ununiforms) have been increasing since 2010, accounting for 18% of commercialized animals in 2014. However, they were the least valued genetic group, receiving discounts of -3.56% in relation to the median. According to Christofari et al. (2008), there is greater acceptance when the crossing is pre-established and the lot is standardized. According to Christofari et al. (2009), standardization can be achieved through the acquisition of genetically similar

animals of similar age and development. Uniform batch preferences in auctions in North America were also reported by Smith et al. (2000) and Schulz et al. (2010).

Ununiform lots were observed to be among the heaviest (Table 6). However, this group was the only one that received discounts in relation to the median, and lots of British animals that were among the lightest were the most valued. According to Troxel et al. (2002), buyers hesitate in bidding on batches of undefined breeds. The lack of standardization of lots (horns, poor musculature, rough coat, and so on) may cause devaluation (Smith et al., 2000). There are many factors that influence the selling price of calves, some of which farmers can control, and understanding the needs of the market can mean better profitability.

In 2009, 2010, 2012, and 2013, the direct effect of the month of sale was not significant ($P>0.05$). According to Dhuyvetter and Schroeder (1999), the marketing season is generally less important than other variables, such as price of steers and sex of the animals. Therefore, as the positive and negative indirect effects were small and no correlation coefficient is greater than the residual effect, the contribution of month to selling price is considered small.

There was a direct relationship between the average weight of the lots and the month of the auctions in terms of the degree of premium (Table 4). Lots were heavier and received a larger premium in February and November (8.84 and 9.57%, respectively). The high weight and consequent valuation of animals born in February was mainly due to the age of these animals. With peak season defined as from December to February, these animals were born between August to October of the previous year. Cows calving at the beginning of the breeding season will have a longer time to recover physiologically and nutritionally from gestation and as there is greater availability of good quality pasture, the energy will be directed to milk production, resulting in heavy calves being weaned. In addition, the farmer contributed to the formation of prices, with only 2% of the lots sold in February. In agreement with the results that a higher premium was observed in November auctions, Troxel et al. (2002) and Christofari et al. (2010) observed that the highest calf value is achieved in the spring rather than in the autumn. These authors argued that this difference is due to the age of the animals, since in spring, the animals offered are, to a large extent, born the previous spring and arrive at auction aged around 9 to 10 months. Another explanation is the increasing use of crop-livestock integration (CLI) in the southern region of Brazil, which is characterized by corn/soybean crops in the summer and cultivated pastures in the winter. Many farmers use these pastures to feed the herd, which causes cows to produce more milk and calves to be heavier when weaned. The increase of this practice can be corroborated by the number of lots in November (14%). That was lower than in March (25%) and May (15%), which is traditionally when calves are sold in the south of Brazil due to the onset of winter. Regardless of the months used, the use of a defined peak season in which calving is concentrated in the beginning of the season may result in superior performance (Cubas et al., 2001).

Conclusions

The average weight of the lot is the most influential variable in the selling price, followed by the sex of the animals. Commercialization in November represents a larger premium compared with the annual median.

The British × Zebuine genetic group is the most valued in relation to the median, but the value does not differ from that of the British genetic group.

In that scenario, calf producers have three alternatives to maximize their sales. Firstly, to increase the weaning weight of the animals; secondly, to concentrate their sales in November; or thirdly, to market British breed animals that were more valued. However, choosing to sell heavier animals was the best long-term alternative observed. As supply increases at the time of price peaking, usually in November, that might cause a price decrease. Since breeding programs using British breeds are phased out, others might arise; thus, buyers would value other types of animal.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization: M.M. Danielce, W. Paris, E.S. Vismara and L.F.G. Menezes. Data curation: M.M. Danielce and M.M. Severo. Formal analysis: E.S. Vismara and L.F.G. Menezes. Funding acquisition: L.F.G. Menezes. Investigation: M.M. Danielce, M.M. Severo and L.F.G. Menezes. Methodology: M.M. Danielce, E.S. Vismara and L.F.G. Menezes. Project administration: L.F.G. Menezes. Supervision: L.F.G. Menezes. Writing-original draft: M.M. Danielce and M.M. Severo. Writing-review & editing: W. Paris and L.F.G. Menezes.

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